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**PUBLICATION FONDAMENTALE DE SÉCURITÉ
BASIC SAFETY PUBLICATION**

**Insulation coordination for equipment within
low-voltage systems –**

**Part 5:
Comprehensive method for determining
clearances and creepage distances equal to
or less than 2 mm**

**Coordination de l'isolement des matériels
dans les systèmes (réseaux) à basse tension –**

**Partie 5:
Méthode détaillée de détermination des distances
d'isolement dans l'air et des lignes de fuite
inférieures ou égales à 2 mm**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INSULATION COORDINATION FOR EQUIPMENT
WITHIN LOW-VOLTAGE SYSTEMS –****Part 5: Comprehensive method for determining clearances
and creepage distances equal to or less than 2 mm**

FOREWORD

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International Standard IEC 60664-5 has been prepared by IEC technical committee 109: Insulation coordination for low-voltage equipment.

This second edition cancels and replaces the first edition, published in 2003 and constitutes a technical revision.

The revision of Part 1 of IEC 60664 also required a revision of Part 5 of IEC 60664, as Part 5 is closely linked to Part 1. In addition to a number of editorial improvements, the following major technical changes made in Part 1 also apply for Part 5:

- Amendment of Japanese mains conditions with regard to the rated impulse voltages, the rationalized voltages and the nominal voltages of supply systems for different modes of overvoltage control.
- Amendment of dimensioning of clearances smaller than 0,01 mm.

- Alignment of the table and the corresponding formula regarding test voltages for verifying clearances at different altitudes.
- Amendment of interpolation of the creepage distance values for functional insulation.
- Revision of the former Clause 4 "Tests and measurements" (now Clause 6) to achieve a more detailed description of the tests and their purpose, the test equipment and possible alternatives.

It has the status of a basic safety publication in accordance with IEC Guide 104.

It is to be used in conjunction with IEC 60664-1.

NOTE For the purposes of this standard, all references to IEC 60664-1 are written as "to Part 1". Where a subclause is cited without reference to a Part, it is assumed that the reference is to the current Part 5.

The text of this standard is based on the following documents:

CDV	Report on voting
109/61/CDV	109/63/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60664 series, under the general title *Insulation coordination for equipment within low-voltage systems*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

INTRODUCTION

This part of IEC 60664 specifies humidity levels regarding the effects of humidity on creepage distances.

This part introduces the following dimensioning criteria which need to be taken into account:

- new minimum clearances having more precise values for dimensions up to 2 mm under pollution degrees 2 and 3 than those specified in Table F.2 of Part 1;
- smaller minimum creepage distances for printed wiring boards and equivalent constructions under pollution degree 3 than those specified in Table F.4 of Part 1;
- a specification of minimum creepage distances to avoid flashover of the insulating surfaces, the values being based on the water adsorption characteristics of the material;
- a specification of minimum creepage distances to ensure adequate insulation resistance under humid conditions.

NOTE Table A.2 provides information on the dimensioning of creepage distances in order to maintain adequate insulation resistance for r.m.s. voltages up to 10 000 V, corresponding to creepage distances up to 250 mm.

The information in this standard is based on research data published in 1989 [1, 2].

The following details from this research provide background information:

- the research was carried out on test samples that were manufactured using the same process as for printed wiring boards with spacing of circuit patterns from 0,16 mm to 6,3 mm;
- ten different materials were used for the test samples. The influence of the manufacturing process on the surface of the material, e.g. moulding or machining, was not part of the research project;
- the test samples were placed in different locations, such as city, rural, industrial, desert, and coastal;
- the samples were periodically exposed to a voltage stress and the data accumulated over a long period of time.

Annex B specifies a water adsorption test method for allocating unclassified insulating material to the relevant water adsorption group. This annex will be reviewed when further experience is gained using the test method for different materials.

¹ Figures in square brackets refer to the bibliography.

INSULATION COORDINATION FOR EQUIPMENT WITHIN LOW-VOLTAGE SYSTEMS –

Part 5: Comprehensive method for determining clearances and creepage distances equal to or less than 2 mm

1 Scope and object

This part of IEC 60664 specifies the dimensioning of clearances and creepage distances for spacings equal to or less than 2 mm for printed wiring board and equivalent constructions, where the clearance and the creepage distance are identical and are along the surface of solid insulation, such as the paths described in 6.2 of Part 1² (Examples 1, 5 and 11).

The dimensioning in this standard is more precise than that provided by Part 1. However, if the precision provided by this standard is not required, Part 1 may be applied instead.

This standard can only be used in its entirety. It is not permitted to select one or more clauses from this standard and to use them in place of the corresponding clauses of Part 1. In addition, this part of IEC 60664 can only be used together with Part 1.

When this Part 5 is applied to the dimensioning of clearances and creepage distances equal to or less than 2 mm, all clauses are used in place of the corresponding clauses given in Part 1. For clearances and creepage distances larger than 2 mm, and for solid insulation in general, Part 1 applies.

NOTE 1 The limitation to distances equal to or less than 2 mm applies to basic or supplementary insulation. The total distance of a reinforced or double insulation may be larger than 2 mm.

This standard is based on the following criteria for dimensioning:

- minimum clearances independent of the micro-environment (see Table 2);
- minimum creepage distances for pollution degrees 1, 2 and 3 to avoid failure due to tracking (see Table 4);
- minimum creepage distances to avoid flashover across the insulating surface (see Table 5).

NOTE 2 For minimum creepage distances to maintain adequate insulation resistance, see Table A.2.

NOTE 3 This standard is not applicable to micro-environmental conditions worse than pollution degree 3 or humidity level 3.

A test method is specified for allocating unclassified insulating material to the relevant water adsorption group.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Clause 2 of Part 1 is applicable, as well as the following:

² "Part 1" refers to IEC 60664-1.

IEC 60364-5-51:2005, *Electrical installations of buildings – Part 5-51: Selection and erection of electrical equipment – Common rules*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60721-3-3:1994, *Classification of environmental conditions – Part 3-3: Classification of groups of environmental parameters and their severities – Stationary use at weatherprotected locations*

IEC 60721-3-7:1995, *Classification of environmental conditions – Part 3-7: Classification of groups of environmental parameters and their severities – Portable and non-stationary use*

IEC 60721-3-9:1993, *Classification of environmental conditions – Part 3-9: Classification of groups of environmental parameters and their severities – Microclimates inside products*

3 Terms and definitions

For the purposes of this document, the following terms and definitions, in addition to those given in Part 1, apply.

3.1

water adsorption

capability of insulating material to adsorb water on its surface

3.2

critical relative humidity

value of the relative humidity when the impulse withstand voltage of a creepage distance has dropped to 95 % of the value that was measured at 70 % relative humidity

4 Fundamentals of clearance and creepage distance dimensioning

4.1 Introductory remark

The first publication on this subject was IEC 60664, 1980. It only covered clearances, the data being based on fundamental data of breakdown voltages. Subsequently, in 1981 IEC 60664A was published concerning creepage distances based on data obtained over many years of experience, as well as data obtained from testing printed wiring boards. In 1992, the publications were combined and published as IEC 60664-1 (Part 1). However, the revision did not change the basic data.

4.2 Basic principles

Insulation coordination implies the selection of the electric insulation characteristics of the equipment with regard to its application and in relation to its surroundings.

Insulation coordination can only be achieved if the design of the equipment is based on the stresses to which it is likely to be subjected during its anticipated lifetime.

Subclause 4.2 of Part 1 is applicable if not specified otherwise below.